

Presented at the FIG Congress 2018,  
May 6-11, 2018 in Istanbul, Turkey

# Geoinformatics in Real World's Regional Million+ Cities: A Geospatial Study of Urbanisation in Emerging and Developing Country, India

**Dr Madan Mohan**

*Associate Professor of Geography*

*Project Director, ICSSR, MoHRD, ND &*

*Project Coordinator, UPE-II, JNU, ND.*



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



*Centre for Study of Regional Development*  
*School of Social Sciences-III*  
**JAWAHARLAL NEHRU UNIVERSITY**  
*New Delhi, INDIA.*



# *Geoinformatics: An Introduction*

- ❖ Geoinformatics is a science dealing with the geospatial information, principally informatics, acquisition systems and digital data processing. Geospatial information linked with geographic space. Geographic space takes into account to urban landscape features of geographic real world.
- ❖ There are many disciplines and techniques which are constituting to the geoinformatics namely, geomatics, geodesy, photogrammetry, remote sensing, geographic information systems, cartography, global navigation and positioning satellite systems, decision support systems, and Web-GIS for mapping of the real world. So, the geoinformatics is the integration of different disciplines dealing with geospatial information and technologies.
- ❖ In this context, geoinformatics will serve as a working tools and technology not only to the geographers and geoscientists; but also to the architects and engineers, computer scientists, surveyors, social scientists and urban planners.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



*Centre for Study of Regional Development*  
*School of Social Sciences-III*  
**JAWAHARLAL NEHRU UNIVERSITY**  
*New Delhi, INDIA.*





# *Urbanisation: An Introduction*

- ❖ India is the second most populous country in the world with more than one sixth of the world's population. According to the 2011 Census, the urban population grew to 377.1 million as compared to 286.1 million in 2001 census showing a growth of 2.76 per cent per annum during 2001-2011.
- ❖ Level of urbanization in the country as a whole increased from 25.70 per cent in 1991 to 27.82 per cent in 2001 and to 31.14 per cent in 2011 which is an increase of 3.30 percentage points during 2001-2011 compared to an increase of 2.10 percentage points during 1991-2001.
- ❖ Whereas, a large number of new towns emerged during the decade, contributing significantly to the speeding up of urbanization.
- ❖ The urban population is projected to grow to about 600 million which comprises to about 40 per cent by 2031 and 850 million which is accounted for about 50 per cent by 2051.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



*Centre for Study of Regional Development*  
*School of Social Sciences-III*  
**JAWAHARLAL NEHRU UNIVERSITY**  
*New Delhi, INDIA.*



# *Objectives of the Study*

Main idea of study is to examine and to comprehend geographical scenario of urbanisation over periods with help of geoinformatic techniques as by way of digitalisation of geospatial urban information for country, India in context to main objectives of present study which are mentioned as follows:

- i. to understand geospatial approaches role in process of historical urbanisation;
- ii. to scrutinize geospatial trends, patterns and associations of urbanization;
- iii. to examine geospatial distribution and growth of population in million+ cities;
- iv. to suggest suitable strategies and policy issues for sustainable urbanisation.

However, present research has made an attempt to help local, regional and state level urban planners and policy makers to better understand and address issues attributed to urbanisation in context to Real World.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



*Centre for Study of Regional Development*  
*School of Social Sciences-III*  
**JAWAHARLAL NEHRU UNIVERSITY**  
*New Delhi, INDIA.*





# *Database and Research Methodology*

- ❖ The present study is based on secondary data available from the different sources. The Census of India publications as the Primary Census Abstract 2001 and 2011.
- ❖ The Village and Town Directory for 2001 and 2011, were also obtained from the Office of the Registrar General & Census Commissioner, India, New Delhi.

According to Census of India 2011, demarcation of urban area is based on the specified criteria:

- ❖ Firstly, “all places with a municipality, corporation, cantonment board or notified town area committee, etc. (known as statutory town);
- ❖ secondly, all other places which satisfied the following criteria (known as census town) as:
  - (a) a minimum population of 5,000;
  - (b) at least 75 per cent of the male main working population engaged in non-agricultural pursuits; and
  - (c) a density of population of at least 400 persons per sq. km”.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



*Centre for Study of Regional Development*  
*School of Social Sciences-III*  
**JAWAHARLAL NEHRU UNIVERSITY**  
*New Delhi, INDIA.*



# *Database and Research Methodology...*

- ❖ Statistical techniques as the ratios have been computed for the States, districts, towns and cities and so on levels of digital information for the country, India.
- ❖ GIS spatial analysis technique, the geovisualisation of spatial data have been performed for the presentation of the geospatial distribution patterns of the urban settlements as towns and cities and level of urbanisation. So, the chorochromatic and choropleth maps have been generated for the different periods for India.
- ❖ Imagery is acquired by satellite's instrument is the Visible Infrared Imaging Radiometer Suite (VIIRS). It detects photons of light reflected from Earth's surface and atmosphere in 22 different wavelengths. VIIRS is the first satellite instrument to make quantitative measurements of light emissions and reflections.
- ❖ It allows researchers to distinguish the intensity, types and the sources of night lights for different purposes as identification of settlements or spread of urbanisation.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



*Centre for Study of Regional Development*  
*School of Social Sciences-III*  
**JAWAHARLAL NEHRU UNIVERSITY**  
*New Delhi, INDIA.*





# Study Area

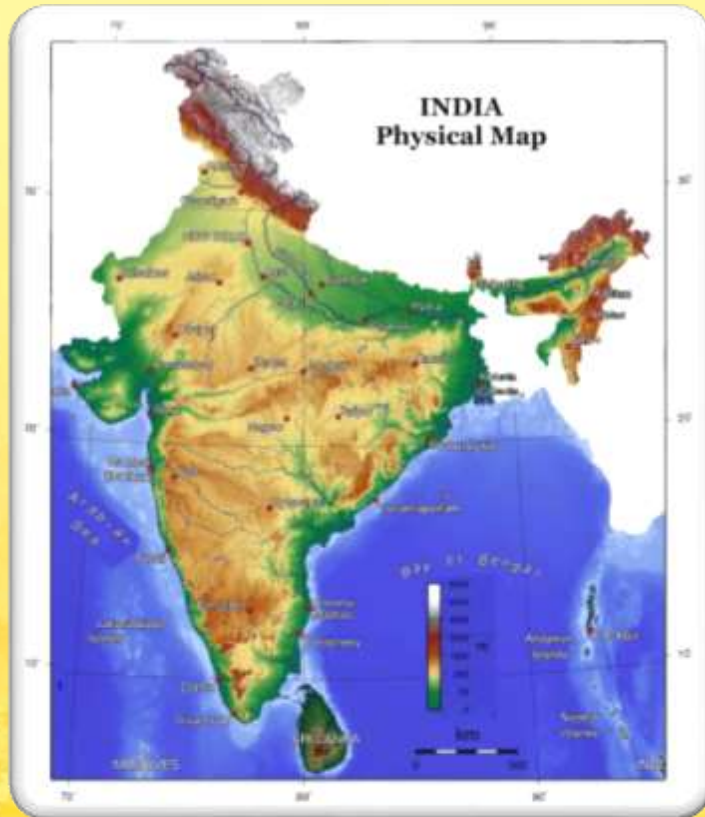


Figure 1: Physical Map, India.

Source: Col (2011) Census of India 2011, Primary Census Abstract, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi.

- ❖ India is situated to the north of equator, between the geographical extent of  $08^{\circ} 04'$  and  $37^{\circ} 06'$  north latitudes and  $68^{\circ} 07'$  and  $97^{\circ} 25'$  east longitudes.
- ❖ Physiographical features reveals that the lofty Himalayans covered with snow and glaciers are lying in the north.
- ❖ The Great Indo-Gangetic Planes with fertile land drained by navigable perennial rivers are lying below the Himalayas.
- ❖ The Peninsular India is geologically oldest stable landmass rich in mineral resources surrounded by seas as Arabian Sea, Bay of Bengal and Indian Ocean lying in the south as is evidenced by the Figure 1.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



Centre for Study of Regional Development  
School of Social Sciences-III  
JAWAHARLAL NEHRU UNIVERSITY  
New Delhi, INDIA.





# Study Area ...



**Figure 2: State level Divisions.**



**Figure 3: District level Divisions.**

Source: Col (2011) Census of India 2011, Primary Census Abstract, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi.

- ❖ Besides this, the States level as well as the districts level latest available administrative divisions at the states level and districts level based on the Census of India, 2011 are also presented in the Figure 2 and Figure 3, respectively.
- ❖ However, the Land information in terms of administrative divisions' statistics showed that there were 28 States which contains about 640 districts in 2011.
- ❖ Likewise, there were around 5,924 sub-districts which comprised by tehsils, talukas and blocks.
- ❖ In addition to this, there was a large number of villages which accounted for about 6,40,930 villages in the country, India during 2011.s



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



Centre for Study of Regional Development  
School of Social Sciences-III  
JAWAHARLAL NEHRU UNIVERSITY  
New Delhi, INDIA.





# Geospatial Trends of Urbanisation

Urban Population	1981	1991	2001	2011
Urban Population (as % to total population)	23.73	26.13	27.82	31.20
Statutory Towns	-	-	3,799	4,041
Census Towns	-	-	1,362	3,894
All Class Towns & Cities – Urban Settlements & Centres (I-VI size classes)	4,019	4,680	5,161	7,935
Urban Agglomerations (UA) & Cities *	216	296	394	475
Urban Out Growth (OG)	-	-	962	981
Metropolitan cities**	12	23	35	53

- ❖ Proportion of population living in urban areas of country was increased from 27.82 per cent in 2001 to about 31.20 per cent in 2011.
- ❖ Number of towns was increased from 5,161 in 2001 to 7,935 in 2011.
- ❖ Such kind of increasing pace of urbanization resulted into increasing pressure on level of services in urban centers.
- ❖ So, by and large, the urbanization has also been accompanied with an increase in the urban poor population.

Notes:

\* Class-I Town/City with population of 1, 00,000 & above;

\*\* Metropolitan Cities having population more than million plus (+);

Source:

CoI (2011) *Census of India 2011, Primary Census Abstract*, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



Centre for Study of Regional Development  
School of Social Sciences-III  
JAWAHARLAL NEHRU UNIVERSITY  
New Delhi, INDIA.



# Geospatial Trends of Urbanisation

Size of Population	Class/Category	1981	1991	2001	2011
1,00,000 & above	I	226	322	441	468
50, 000 to 99, 999	II	325	421	496	601
20, 000 to 49, 999	III	883	1,161	1,399	2,047
10, 000 to 19, 999	IV	1,247	1,451	1,563	2,451
5, 000 to 9, 9999	V	920	971	1,041	2,147
Less than 5, 000	VI	348	289	232	221
	<b>Total</b>	<b>3,949</b>	<b>4,615</b>	<b>5,161</b>	<b>7,935</b>

- ❖ In the Census 2011, there are about 468 such urban centers. The corresponding number of such towns was about 441 in 2001 Census.
- ❖ There were about 264.90 million persons, constituting 64.82 per cent of the total urban population, who live in these Class I towns and urban agglomerations as evidenced by the Table 3.
- ❖ Besides this, the proportion of Class I towns was increased in 2011 Census in comparison to the previous 2001 Census.

Source: CoI (2011) *Census of India 2011, Primary Census Abstract*, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES

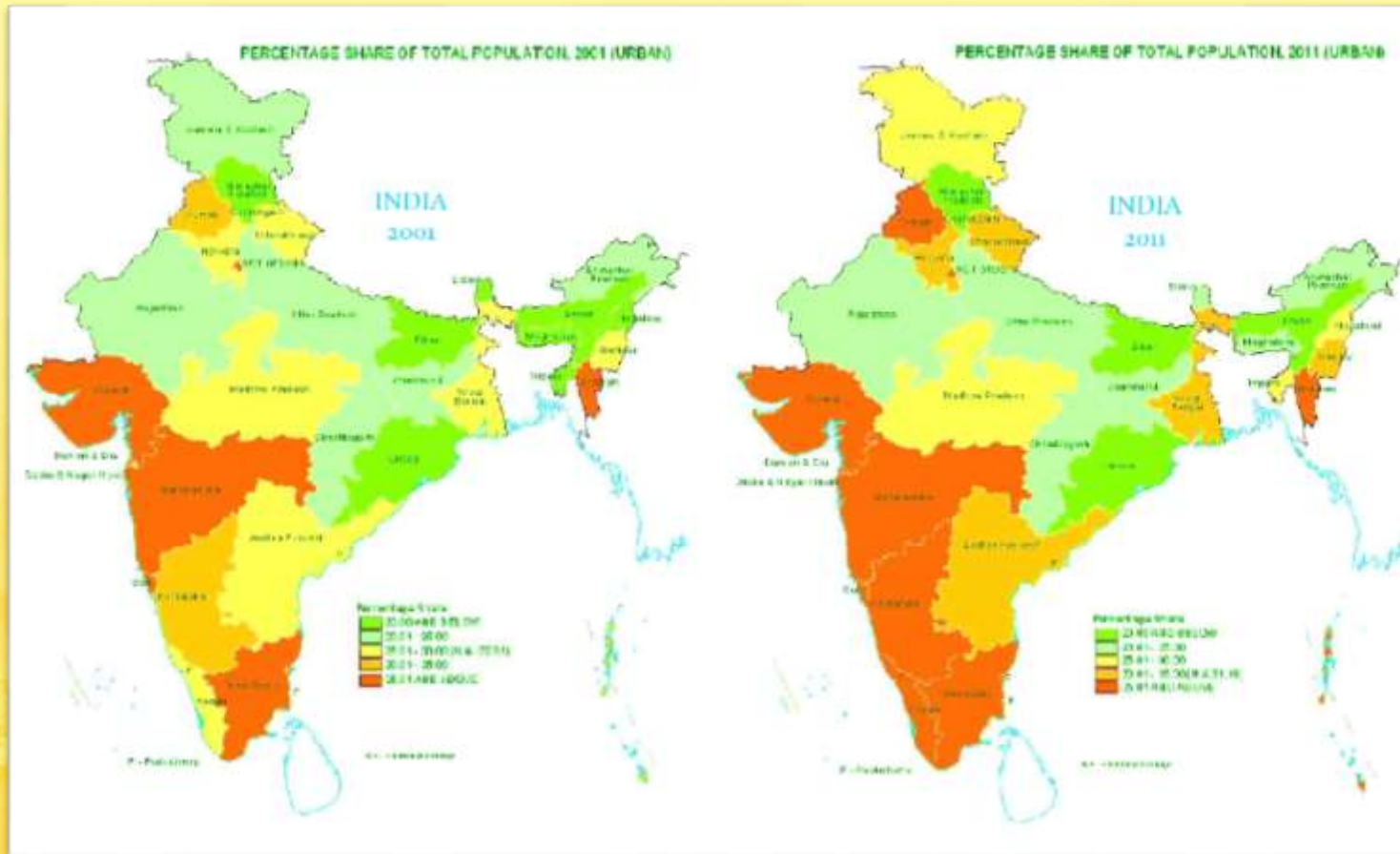


Centre for Study of Regional Development  
School of Social Sciences-III  
JAWAHARLAL NEHRU UNIVERSITY  
New Delhi, INDIA.





# Geospatial Patterns of Urbanisation



- ❖ Geospatial patterns of urbanization in terms of the percentage share of urban population to total population was found high among the industrialized States.
- ❖ Particularly, the western and southern States as the Gujarat, Maharashtra, Tamil Nadu in 2001 and likewise in 2011 with the addition of Karnataka State in the country as evidenced by the Figures 3 and 4.

Source: CoI (2011) *Census of India 2011, Primary Census Abstract*, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



Centre for Study of Regional Development  
School of Social Sciences-III  
JAWAHARLAL NEHRU UNIVERSITY  
New Delhi, INDIA.



# Geospatial Patterns of Urbanisation

Sl. No.	India/State/ Union Territory #	% Urban Population 2001	% Urban Population 2011	% Urban Growth Rate: 2001-2011
1	Andhra Pradesh	27.30	33.49	36.26
2	Arunachal Pradesh	20.75	22.67	37.55
3	Assam	12.90	14.08	27.61
4	Bihar	10.46	11.30	35.11
5	Chhattisgarh	20.09	23.24	41.83
6	Goa	49.76	62.17	35.15
7	Gujarat	37.36	42.58	35.83
8	Haryana	28.92	34.79	44.25
9	Himachal Pradesh	9.80	10.04	15.64
10	Jammu & Kashmir	24.81	27.21	35.66
11	Jharkhand	22.24	24.05	32.29
12	Karnataka	33.99	38.57	31.27
13	Kerala	25.96	47.72	92.72
14	Madhya Pradesh	26.46	27.63	25.63
15	Maharashtra	42.43	45.23	23.67
16	Manipur	25.11	30.21	42.74
17	Meghalaya	19.58	20.08	31.03
18	Mizoram	49.63	51.51	27.43
19	Nagaland	17.23	28.97	67.38
20	Orissa	14.99	16.68	26.80

21	Punjab	33.92	37.49	25.72
23	Rajasthan	23.39	24.89	29.26
24	Sikkim	11.07	24.97	153.43
25	Tamil Nadu	44.04	48.45	27.16
26	Tripura	17.06	26.18	76.08
27	Uttar Pradesh	20.78	22.28	28.75
28	Uttarakhand	25.67	30.55	41.86
29	West Bengal	27.97	31.89	29.90
1	A & N Islands #	32.63	35.67	16.64
2	Chandigarh #	89.77	97.25	26.86
3	Dadra & Nagar Haveli #	22.89	46.62	216.73
4	Daman & Diu #	36.25	75.16	218.37
5	Lakshadweep #	44.46	78.08	86.55
6	NCT Of Delhi #	93.18	97.50	26.56
7	Puducherry #	66.57	68.31	31.07
	INDIA	27.81	31.16	31.80



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



Centre for Study of Regional Development  
School of Social Sciences-III  
JAWAHARLAL NEHRU UNIVERSITY  
New Delhi, INDIA.





# Geospatial Distribution of Million+ Cities

Sl. No.	State Name	No.	Name of Urban Agglomeration/ City	Status	Population 2001	Population 2011	% Growth 2001-2011
1	Andhra Pradesh	1	Hyderabad	UA	5.33	7.75	45.39
		2	GVMC (MC)	City	1.33	1.73	30.10
		3	Vijayawada	UA	1.01	1.49	47.64
2	Bihar	1	Patna	UA	1.71	2.05	19.69
3	Chhattisgarh	1	Raipur	UA	-	1.12	-
		2	Durg-Bhilainagar	UA	-	1.06	-
4	Gujarat	1	Ahmadabad	UA	4.52	6.35	40.54
		2	Surat	UA	2.81	4.59	63.18
		3	Vadodara	UA	1.49	1.82	21.96
		4	Rajkot	UA	1.00	1.39	39.09
5	Haryana	1	Faridabad(MC)	City	1.05	1.40	33.78
6	Jammu & Kashmir	1	Srinagar	UA	-	1.27	-
7	Jharkhand	1	Jamshedpur	UA	1.10	1.34	21.56
		2	Dhanbad	UA	1.06	1.20	12.76
		3	Ranchi	UA	-	1.13	-
8	Karnataka	1	Bangalore	UA	5.69	8.50	49.37
9	Kerala	1	Kochi	UA	1.35	2.12	56.89
		2	Kozhikode	UA	-	2.03	-
		3	Thrissur	UA	-	1.85	-
		4	Malappuram	UA	-	1.70	-
		5	Thiruvananthapuram	UA	-	1.69	-
		6	Kannur	UA	-	1.64	-
		7	Kollam	UA	-	1.11	-
10	Madhya Pradesh	1	Indore	UA	1.64	2.17	32.16
		2	Bhopal	UA	1.45	1.88	29.89
		3	Jabalpur	UA	1.12	1.27	13.18
		4	Gwalior	UA	-	1.10	-

11	Maharashtra	1	Greater Mumbai	UA	16.37	18.41	12.49	
		2	Pune	UA	3.75	5.05	34.67	
		3	Nagpur	UA	2.12	2.50	17.82	
		4	Nashik	UA	1.15	1.56	35.89	
		5	Vasai Virar City (MC)	City	-	1.22	-	
		6	Aurangabad	UA	-	1.19	-	
12	Punjab	1	Ludhiana (MC)	City	1.40	1.61	15.28	
		2	Amritsar	UA	1.01	1.18	17.20	
13	Rajasthan	1	Jaipur (MC)	City	2.32	3.07	32.47	
		2	Jodhpur	UA	-	1.14	-	
		3	Kota (MC)	City	-	1.00	-	
14	Tamil Nadu	1	Chennai	UA	6.42	8.70	35.45	
		2	Coimbatore	UA	1.45	2.15	48.38	
		3	Madurai	UA	1.19	1.46	22.89	
		4	Tiruchirappalli	UA	-	1.02	-	
15	Uttar Pradesh	1	Kanpur	UA	2.69	2.92	8.55	
		2	Lucknow	UA	2.27	2.90	27.82	
		3	Ghaziabad	UA	-	2.36	-	
		4	Agra	UA	1.32	1.75	32.31	
		5	Varanasi	UA	1.21	1.44	18.60	
		6	Meerut	UA	1.17	1.42	21.79	
		7	Allahabad	UA	1.05	1.22	15.88	
16	West Bengal	1	Kolkata	UA	13.22	14.11	6.75	
		2	Asansol	UA	1.09	1.24	14.04	
<i>Union Territories</i>								
1	Chandigarh	1	Chandigarh	UA	-	1.03	-	
2	NCT of Delhi	1	NCT of Delhi	UA	12.79	16.31	27.56	
					<b>Total Population</b>	<b>107.65</b>	<b>160.73</b>	<b>49.30</b>



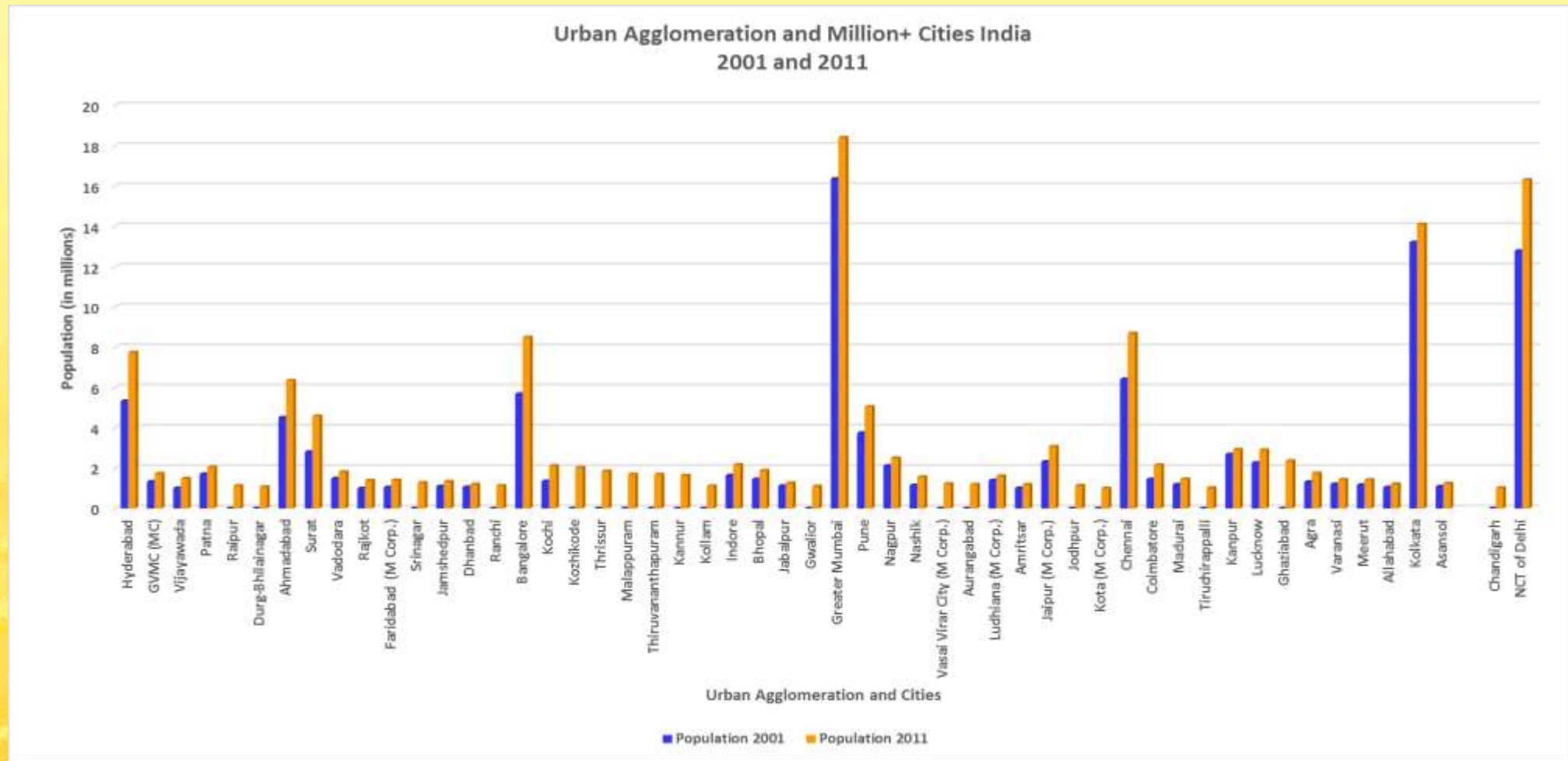
06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



Centre for Study of Regional Development  
School of Social Sciences-III  
JAWAHARLAL NEHRU UNIVERSITY  
New Delhi, INDIA.



# Geospatial Distribution of Million+ Cities



06-11 MAY 2018  
 EMBRACING OUR SMART WORLD  
 WHERE THE CONTINENTS CONNECT:  
 ENHANCING THE GEOSPATIAL  
 MATURITY OF SOCIETIES

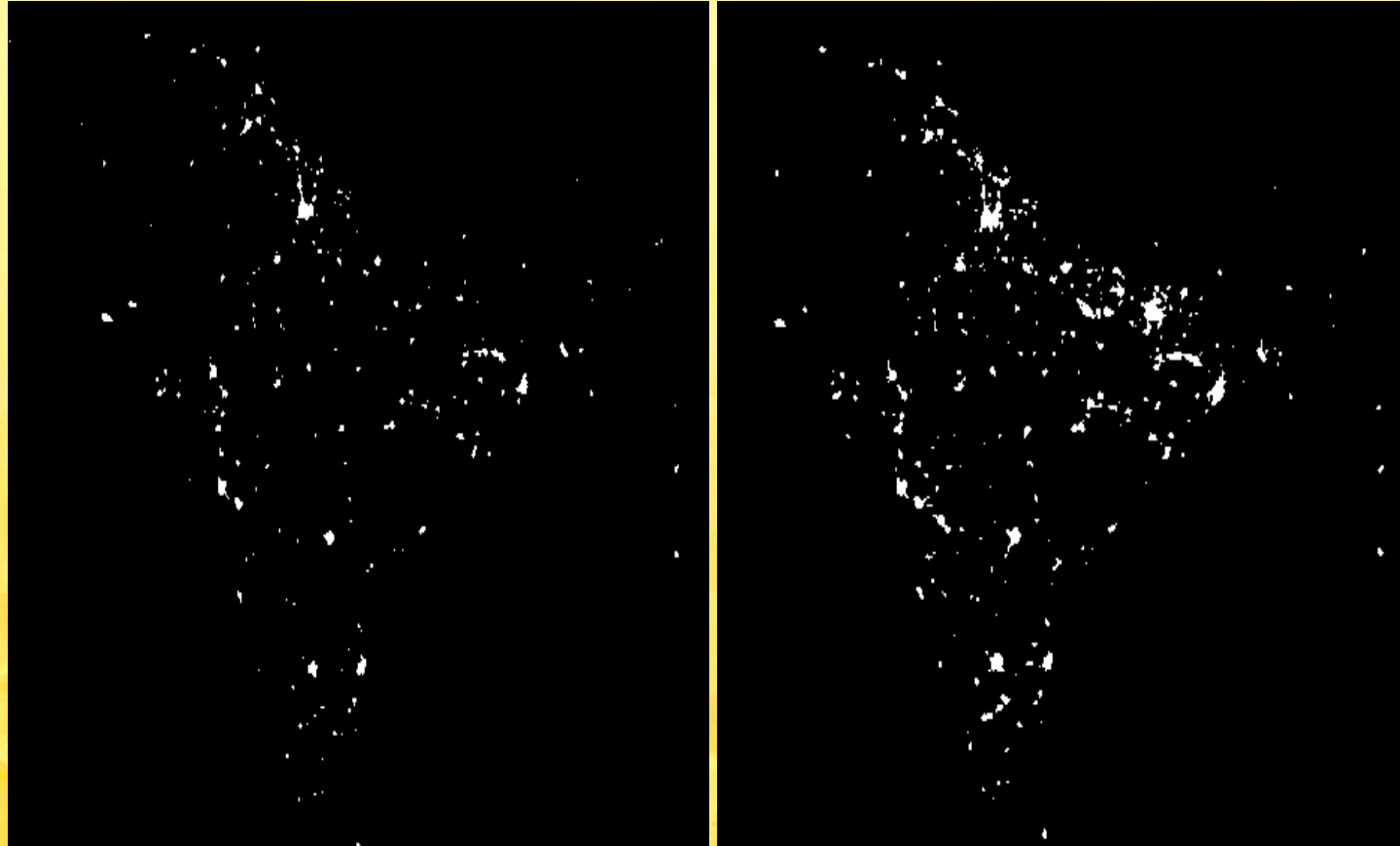


Centre for Study of Regional Development  
 School of Social Sciences-III  
 JAWAHARLAL NEHRU UNIVERSITY  
 New Delhi, INDIA.





# NASA Imagery of Human Settlements



- ❖ NASA's satellite images of Earth at night known as 'night lights' have lots of curiosity to the public.
- ❖ Such imagery shows the human settlements where lights have been used to light-up darkness.
- ❖ such imagery show geospatial spread of economic and socio-cultural development of the human being's settlements as villages, towns, cities and mega cities in India as is evidence by the Figure 6 and 7.

Source: NASA Earth Observatory images, NASA-NOAA Suomi National Polar-orbiting Partnership (NPP) satellite, NASA's Goddard Space Flight Center.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



Centre for Study of Regional Development  
School of Social Sciences-III  
JAWAHARLAL NEHRU UNIVERSITY  
New Delhi, INDIA.



# Conclusions and Suggestions

- ❖ It is noteworthy to mention that out of the total population of 1210.19 million, about 377.10 million live in urban areas which is accounting for 31.15 per cent of the total population in 2011.
- ❖ Proportion of population living in the urban areas of country were increased from 27.80 per cent in 2001 to about 31.15 per cent in 2011. The number of towns have also been increased from 5,161 in 2001 to 7,935 in 2011.
- ❖ There were about 12 cities in 1981, which was almost doubled to about 23 in 1991. Moreover, their number was further increased to about 35 in 2001 and to about 53 in 2011.
- ❖ So, the urban population projections indicate that by 2031, the urban population will be about 600 million constituting over 40 per cent of total population in India.
- ❖ The Cities have, in effect become an indicator of humankind's progress into the 21<sup>st</sup> century, whether this is an upward trend or downward.
- ❖ India's cooperation with other countries in the urban development is a step in the right direction leading to cross learning and arriving at practical solutions.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



*Centre for Study of Regional Development*  
*School of Social Sciences-III*  
**JAWAHARLAL NEHRU UNIVERSITY**  
*New Delhi, INDIA.*





# Conclusions and Suggestions ...

- ❖ Urban Development Ministry has signed Memorandum of Understanding (MoU) with countries like Netherlands, Japan, Germany, France, Sweden, Singapore and so on.
- ❖ India has set a global trend towards increasing urbanisation in which more than half of world's population is living in towns and cities. Cities hold tremendous potential as engines of economic social development, creating jobs generating wealth through economies of scale.
- ❖ NASA's satellite images of Earth at night known as 'night lights' have lots of curiosity to the public. Scientist at NASA have been analyzing night lights imagery.
- ❖ Such imagery shows the human settlements where lights have been used to light-up darkness. Main aim of imagery is gathering a better and more consistent signal of how human-driven patterns and processes are changing over the surface of earth.
- ❖ present research has made an attempt to help local, regional and state level urban planners and policy makers to better understand and address issues attributed to urbanisation in context to Real World's India.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



*Centre for Study of Regional Development*  
*School of Social Sciences-III*  
**JAWAHARLAL NEHRU UNIVERSITY**  
*New Delhi, INDIA.*



# Acknowledgements

The author acknowledges the support provided by Professor S. K. Thorat, Chairman, Indian Council of Social Science Research (ICSSR), Ministry of Human Resource Development (MoHRD), Govt. of India, New Delhi, for valuable suggestions. The author is also indebted to him for the financial support provided for the on-going research project on “**Geospatial Digitalisation of Big Data using Geoinformatics ...**”. The present paper is also a subsidiary research outcome of the on-going project.



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



Centre for Study of Regional Development  
School of Social Sciences-III  
JAWAHARLAL NEHRU UNIVERSITY  
New Delhi, INDIA.





---

# *Thank You*



06-11 MAY 2018  
EMBRACING OUR SMART WORLD  
WHERE THE CONTINENTS CONNECT:  
ENHANCING THE GEOSPATIAL  
MATURITY OF SOCIETIES



*Centre for Study of Regional Development*  
*School of Social Sciences-III*  
**JAWAHARLAL NEHRU UNIVERSITY**  
*New Delhi, INDIA.*

